

Frame structure for an enclosure for electrical equipment

The invention relates to a frame structure for a rack for electrical equipment. The invention also relates to a rack for electrical equipment, and to a flat pack from which such a rack can be formed. The rack will usually be clad with panels and thus take the form of what is referred to herein as an enclosure, but it may also be used without such panels.

It is well known to provide an enclosure that comprises a frame made up of various members with panels secured over the frame. At least some of the panels may be detachable to improve access to the frame. Commonly, the frame is a cuboidal frame and the frame members are connected to one another at each of the corners of the frame. Thus, at each corner one vertical member and two horizontal members are connected together. To assemble the frame, it is then necessary merely to complete whatever assembly is required at each corner.

A wide variety of arrangements for corner connections of frame members are known. One common approach is to provide as a separate member a corner joint having three orthogonal projections each of which provides a fixing facility for a respective frame member. Providing such an additional member can be very effective but leads to additional cost and complication.

It is an object of the invention to provide a frame structure which is effective but is inexpensive to manufacture and/or easy to assemble.

In a first aspect, the present invention provides a frame structure for a rack for electrical equipment, the frame structure comprising a plurality of elongate members which are joined together at corners of the structure, the frame structure including a corner joint at which two horizontal frame members and one vertical frame member are joined together, the horizontal frame members and the vertical frame member including portions which are juxtaposed to one another and are secured together by a common fastener engaging the juxtaposed portions.

The frame structure can be made inexpensively and yet be easy to assemble because no additional corner member need be provided and a common fastener is used to join together the three frame members that form the corner joint, thereby offering a reduction in the total number of fastening operations that are required.

It is an especially advantageous feature of the invention that at least one, and preferably each, of the three frame members that form the corner joint are formed from sheet metal bent into the desired shape. In that way, assembly can be simplified and construction costs can be reduced.

Preferably a hole is provided in each of the three portions and the common fastener passes through the holes. The fastener may for example comprise male and female threaded parts. Instead of a hole a part of a member may be omitted or cut-away to provide a gap or slot or some other opening and it is also possible, although not preferred, for two of the juxtaposed portions on opposite outer sides of the middle juxtaposed portion to have an appropriate fastening means engaging their inner faces in some way and thereby securing the members together.

Preferably a first one of the frame members is of hollow section and a second one of the frame members passes through an opening in a wall of the first frame member. Forming a frame member as a member of hollow section is not itself a novel proposal and frame members of a variety of hollow sections are known *per se*. By arranging for a second one of the frame members to pass through an opening in a wall of the first frame member, it becomes possible to maintain substantial strength for the first frame member whilst facilitating the securing together of all three frame members by a common fastener. The opening may comprise a cut-away portion in the form of a slot but is preferably a substantially rectangular hole. The size of the rectangular hole is preferably such that the second frame member fits freely, but preferably snugly, through the hole. In that case assembly remains straightforward

and indeed alignment of the members for fastening can be facilitated; furthermore extra resistance is provided against distortion of the corner joint after assembly.

Preferably a third one of the frame members passes
5 through an opening in a further wall of the first frame member. Again the opening in the further wall is preferably defined by a substantially rectangular hole, and the third frame member is preferably a snug fit in the hole.

10 Preferably, the second frame member is of hollow section and the third frame member passes through an opening in a wall of the second frame member. In an embodiment of the invention described below, the opening in the wall of the second frame member is defined by cut-away
15 portions of a pair of walls (flanges) of the second frame member; another possibility, however, would be to provide a rectangular hole. With arrangements of the kind just described it becomes a simple matter to arrange for portions of the three members to be juxtaposed to one
20 another and secured together by a common fastener, but at the same time to provide a strong fixing. For example, this can easily be arranged by providing an end wall on the third frame member perpendicular to its longitudinal axis.

Various orientations of the corner joint are workable,
25 but preferably the first frame member referred to above is the vertical frame member.

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Where a frame member is formed from sheet metal bent into the desired shape, any opening in the frame member can be formed by punching out the metal that is not required, preferably before the metal is bent into the desired shape.

5 Also any required flanges can simply be formed as part of the frame member by appropriate bending. Furthermore a frame member need not have a closed section but may for example be formed with a longitudinal slot along all or part of one side of the frame member.

10 Whilst reference is made above to a common fastener engaging the juxtaposed portions of the frame members, it should be understood that further fasteners may be provided engaging the same juxtaposed portions of the frame members or other parts of two or all three frame members. Thus, at
15 least two of the frame members may include further portions which are juxtaposed to one another and extend in planes transverse to the planes of the first-mentioned juxtaposed portions, the further juxtaposed portions being secured together by a further common fastener engaging the further
20 juxtaposed portions. In both embodiments of the invention described below a further fastener engages further juxtaposed portions of the second and third frame members. In one of the embodiments of the invention described below a further fastener engages the juxtaposed portions of the
25 vertically extending frame member and the second frame member. In the case where the first frame member extends

vertically, the further fastener may also serve as a fastening location for a top panel of the enclosure (if the corner joint is at the top of the enclosure) or for a bracket supporting a castor or the like (if the corner joint is at the bottom of the enclosure).

Preferably, the structure includes eight corner joints that are all substantially identical to each other, and the horizontally extending frame members are all substantially identical to each other. In that way assembly can be simplified and manufacturing costs can be reduced. Furthermore the cross-sectional shape of the second and third members can conveniently be identical.

Preferably, the frame structure is substantially cuboidal.

In a second aspect, the present invention provides a frame structure for a rack for electrical equipment, the frame structure comprising a plurality of elongate members which are joined together at corners of the structure, the frame structure including a corner joint at which two horizontal frame members and one vertical frame member are joined together, a first one of the frame members being of hollow section and a second one of the frame members passing through an opening in a wall of the first frame member.

The frame structure according to the second aspect of the invention may further comprise any of the features of

the frame structure according to the first aspect of the invention.

Where reference is made herein to an "enclosure", the term "enclosure" should not be taken to imply that there are continuous walls defining a fully closed space. In general it is desirable for there to be panels fitted to the frame structure in order both for the connections to be protected and for persons to be protected from the connections. It should be understood however, that it is within the scope of the present invention to provide an enclosure with only some panels or indeed a rack without any panels.

The present invention further provides a rack for electrical equipment comprising a frame structure according to the invention. Preferably the rack is an enclosure and includes one or more panels secured to the frame structure.

The present invention further provides a flat pack comprising a plurality of frame members for assembly on site into a rack for electrical equipment as defined above.

Preferably the rack or enclosure is suitable for having connections of cables in a telecommunications or data communications network.

By way of example, an embodiment of the invention will now be described with reference to the accompanying drawings, of which:

Fig. 1 is a perspective view of a portion of a skeleton frame structure for a rack for telecommunications or data communications equipment;

5 Fig. 2 is an exploded view of the portion of the structure shown in Fig. 1;

10 Fig. 3 is a perspective view of a portion of a skeleton frame structure for a rack for telecommunications or data communications equipment, similar in many respects to that in Fig. 1

Fig. 4 is an exploded view of the portion of the structure shown in Fig. 3; and

15 Fig. 5 is a perspective view of an entire skeleton frame structure.

Figs. 1 and 2 show a corner portion of a skeleton frame structure for a rack (which may be clad with panels to form an enclosure) suitable for housing connections of cables in a telecommunications or data communications network. The skeleton frame structure comprises four vertically extending frame members and eight horizontally extending frame members joined together at their ends to define a cuboid. The skeleton frame structure therefore includes eight corner joints each comprising one vertically extending frame member joined to two horizontally extending frame members. Figs. 1 and 2 illustrate one such corner

joint. The other seven corner joints are substantially the same as that shown in Figs. 1 and 2.

The joint comprises a vertically extending member 1, a first horizontally extending member 2, and a second horizontally extending member 3. Only one end of each member is illustrated. It will be understood that one of the members 2, 3 will extend along a side of the frame structure and the other of the members 2, 3 will extend along the front or rear of the frame structure. In the particular example described the member 3 is a side member and the member 2 a rear member. All three members 1, 2, 3 are formed from sheet metal pressed into a desired configuration. The three members may also be formed by extrusion, if desired.

The vertically extending member 1 is of generally square cross-section and comprises two adjacent, mutually perpendicular, outer walls 1a, 1b. The wall 1a is joined along one edge to the wall 1b and along an opposite edge to a wall 1c which extends inwardly from the wall 1a perpendicular thereto. A portion of the wall 1c is cut away to form a rectangular hole 4. The wall 1b is joined along one edge to the wall 1a and along an opposite edge to a wall 1d which extends inwardly from the wall 1b perpendicular thereto and carries a flange 1e on its distal edge, the flange 1e extending perpendicular to the wall 1d

and away from the wall 1a. A portion of the wall 1d is cut-away to form a rectangular hole 5.

The rear member 2 is of generally rectangular cross-section and comprises an outer wall 2a joined along each of its opposite side edges to walls 2b, 2c which project inwardly perpendicular to the wall 2a. Each wall 2b, 2c is formed along its inner edge with an internal flange 2d, 2e respectively, those flanges being disposed in a common plane parallel to the wall 2a. The side member 3 is also of a similar generally rectangular cross-section including walls 3a, 3b, 3c and flanges 3d, 3e. Flanges 2d and 2e are each cut-away at their ends to leave gaps 8, 9 respectively, and circular holes 6, 7 are provided in the walls 2a, 2c respectively towards the ends of the walls.

The side member 3 is formed with an end wall 3f perpendicular to the walls 3a, 3b, 3c and to the flanges 3d, 3e. A circular hole 10 is provided in the middle of the end wall 3f and a circular hole 11 is provided in the wall 3c towards the end of the wall. The corner joint is assembled by passing the illustrated end of the rear member 2 through the rectangular opening 4 in wall 1c of the vertically extending member 1 until the member 2 abuts the outer wall 1b of the member 1; at that stage, the circular hole 6 in the outer wall 2a of the rear member 2 is aligned with a circular hole 12 provided in the outer wall 1a of the vertically extending member 1. The side member 3 is

then passed through the opening 5 in wall 1d of the vertically extending member 1 and subsequently through the gaps 8, 9 in the flanges 2d, 2e of the rear member 2 until the end wall 3f of the side member 3 abuts the inner side of the outer wall 2a of the rear member 2. At that stage, the hole 10 in the end wall 3f of the side member 3 is aligned with the hole 6 in the wall 2a of the rear member 2, and with the hole 12 in the outer wall 1a of the vertically extending member 1; also, the hole 11 in the wall 3c of the side member 3 is aligned with the hole 7 in the wall 2c of the rear member 2. The three members 1, 2, 3 are then secured together by passing a fastener 13 through holes 12, 6, 10. A fastener 14 can also be passed through holes 7, 11; such a fastener may be provided to fix a castor or other base member to the frame but may also have the effect of further strengthening the connection between the frame members.. If desired, for added strength, the three members 1, 2, 3 may each include a further hole (not shown) in their respective walls 1a, 2a and 3f, the three further holes being positioned such that, once the skeleton frame structure has been assembled, the three further holes are aligned and a further fastener can be passed through the holes. Conveniently the fastener in each case comprises a screw threaded bolt that is passed from the outside of the frame structure through the holes and engages a screw threaded female member fixed on the

inner face of the innermost juxtaposed wall (the wall 3f for the fastener 13 and the wall 3c for the fastener 14).

Figs. 3 and 4 show a corner portion of a skeleton frame structure for a rack, similar in many respects to that shown in Figs. 1 and 2. The same reference numerals are used to designate corresponding parts.

The following description of the particular example shown in Figs. 3 and 4 relates mainly to those aspects which differ from the example shown in Figs. 1 and 2.

10 In the outer wall 2a, of the rear member 2, there is provided, in addition to the circular hole 6, a second circular hole 15. In the outer wall 1a, of the vertically extending member 1, there is provided, in addition to the circular hole 12, a circular hole 16. The corner joint is
15 assembled by passing the illustrated end of the rear member 2 through the rectangular opening 4 in wall 1c of the vertically extending member 1 until the member 2 abuts the outer wall 1b of the member 1; at that stage, the holes 6 and 15 in the outer wall 2a of the rear member 2 are
20 aligned with the holes 12 and 16 respectively, provided in the outer wall 1a of the vertically extending member 1. The side member 3 is then passed through the opening 5 in wall 1d of the vertically extending member 1 and subsequently through the gaps 8, 9 in the flanges 2d, 2e of the rear
25 member 2 until the end wall 3f of the side member 3 abuts the inner side of the outer wall 2a of the rear member 2.

At that stage, the hole 10 in the end wall 3f of the side member 3 is aligned with the hole 6 in the wall 2a of the rear member 2, and with the hole 12 in the outer wall 1a of the vertically extending member 1; also, the hole 11 in the wall 3c of the side member 3 is aligned with the hole 7 in the wall 2c of the rear member 2. The three members 1, 2, 3 are then secured together by passing a fastener 13 through holes 12, 6, 10 (and, as in the earlier embodiment, a fastener 14 through holes 7, 11). The members 1 and 2 are then further secured together by passing a fastener 17 through holes 16, 15. Like the fasteners 13, 14, conveniently the fastener 17 comprises a screw threaded bolt that is passed from the outside of the frame structure through the holes and engages a screw headed female member fixed on the inner face of the inner most juxtaposed wall, that being the wall 2a.

The members 2 and 3 fit freely but snugly through the rectangular holes 4 and 5 in the member 1. The snug fit both facilitates assembly of the corner joint and resists any significant movement of one frame member relative to another.

Fig. 5 shows a complete frame structure incorporating eight corner joints, each of which is substantially as described above. It will be appreciated that there are various options for the orientations of the various corner joints. In Fig. 5, the form of each end of each of the

members 1, 2, 3 is the same, but another possibility for example would be to provide the member 2, one end of which is shown in Figs. 2 and 4, with its other end in the form of the end of member 3 that is shown in Figs. 2 and 4. In
5 that case the other end of member 3 would be in the form of the end of member 2 that is shown in Figs. 2 and 4.

In Fig. 5, it may be seen that the side members 3 are provided on their flanges 3e with a row of holes to which for example mounting angles of a standard kind known *per se*
10 may be fixed. Equipment such as cable connecting equipment and/or other electrical equipment can then be fixed to the mounting angles in the conventional way. Panels can also be attached to the frame structure by suitable means.

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